CHAPTER

7

Groundwater Quality Management Program

7.1 INTRODUCTION

Water quality is a vital component in the management of the Prescott Active Management Area's (AMA) water supply. The Arizona Department of Water Resources' (Department) role in water quality relates to the impacts of water quality on available water supplies. Protecting and managing water quality maximizes the over-all quantity of usable water, and matching the best use to the quality of water is a significant aspect of meeting the Department's water management objectives. This chapter defines the Department's role and authority in meeting groundwater quality management objectives during the third management period and addresses water quality impacts on the management of water supplies in the Prescott AMA.

The Department's responsibilities in groundwater quality include enhancement of groundwater quality protection programs, assistance in the clean-up of contaminated areas, and assistance in matching water quality with the highest beneficial use. In the third management period, the Department will play a greater role in water quality issues because of increased responsibilities and funding for water quality management activities provided for in the 1997 Water Quality Assurance Revolving Fund (WQARF) Program reform legislation. Laws 1997, Ch. 287. Furthermore, the utilization of renewable supplies such as surface water and treated effluent will play a larger role in water supply activities during the third management period.

In general, groundwater in the Prescott AMA is of acceptable quality for most uses. Most of the groundwater supplies in the Prescott AMA meet federal and state drinking water standards, though contaminant levels exceed primary safe drinking water standards in a few areas. Areas that exceed drinking water standards are monitored to ensure that contaminants do not adversely impact groundwater quality. Currently, the Prescott AMA contains no specific contamination areas identified on the WQARF Priority List or the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) National Priority List.

7.2 GOALS AND OBJECTIVES

Because there are no WQARF or CERCLA sites currently identified in the Prescott AMA, the potential quantity of water that could be used as remediated groundwater is less than in other AMAs. As a result, recent changes to the WQARF program providing incentives to use remediated groundwater do not impact the Prescott AMA as much as they do other AMAs. Spills and accidental releases of contaminants cannot be predicted and greater pressures on water resources as well as increased development raise the likelihood of groundwater contamination, however. Therefore, the Prescott AMA must be prepared to handle issues related to remediated water in the Third Management Plan.

To the extent that WQARF or CERCLA sites are identified in the Prescott AMA, the Department's goals and objectives for groundwater quality management for the third management period are complicated due to the Department's dual responsibilities to achieve reductions in withdrawals of groundwater, and to facilitate remediation of contaminated groundwater by implementing incentives for the use of remediated groundwater. The WQARF reform legislation of 1997 creates several incentives for the use of remediated groundwater. In response to the fact that many sites with groundwater contamination have not been cleaned up, the Legislature mandated incentives for remediated groundwater use which could result in a significant increase in groundwater withdrawals. These incentives to use remediated groundwater present a unique groundwater management problem because they may be in conflict with an underlying objective of the Groundwater Code (Code), which is to "achieve reductions in withdrawals of groundwater" to attain the management goal of each AMA. A.R.S. § 45-563(A).

The Department recognizes that the goal of remediating contaminated groundwater is an important one and intends to facilitate such remediation by implementing incentives for remediated groundwater use. However, as the agency entrusted with the responsibility of managing and conserving Arizona's long-term

water supplies, the Department also has the responsibility to ensure that the minimum amount of groundwater necessary to achieve remedial action objectives is pumped and to ensure that where practicable new groundwater uses are not created and groundwater supplies are conserved. While the Department believes that it is possible to both achieve reductions in withdrawals of groundwater and provide incentives for the use of remediated groundwater, it recognizes that there is a delicate balance between the two responsibilities which will involve coordinated efforts between the Arizona Department of Environmental Quality (ADEQ) and the Department to ensure that, on a case-by-case basis, no more groundwater is withdrawn than is necessary.

To implement its groundwater quality management challenge, the Department will "coordinate and confer" with ADEQ regarding "water plans, water resource planning, water management, wells, water rights and permits, and other appropriate provisions of [title 45] pertaining to remedial investigations, feasibility studies, site prioritization, selection of remedies and implementation of the [WQARF] program pursuant to title 49, chapter 2, article 5." A.R.S. § 45-105(B)(4)(c).

The Department's goals and objectives for groundwater quality management for the third management period are the following:

- to continue monitoring groundwater quality in the Prescott AMA, and to the extent that specific WQARF or CERCLA sites are identified in the Prescott AMA,

- to ensure that remediation of contaminated groundwater uses the minimal amount of groundwater necessary to facilitate the objectives of each remedial action project.

- to ensure that end uses of remediated groundwater minimize groundwater withdrawals and are consistent with the safe-yield goal. Toward this end, the Department will favor end uses that result in no change in groundwater storage such as reinjection and recharge over those that reduce groundwater storage. Where remediated groundwater cannot be practicably or cost-effectively reinjected or recharged, the Department will emphasize replacing existing groundwater uses with remediated water and preventing new permanent uses which would not have occurred without the poor quality groundwater accounting and which would continue to rely on groundwater after the poor quality groundwater is no longer available.

Furthermore, the Department will respond to the highest ranked sites on the WQARF site registry if any are identified. Essentially, the Department's objectives are to ensure that remedial action projects are not an impediment to achieving the safe-yield management goal for the Prescott AMA and that cleanups are performed in a prudent and efficient manner from a water management perspective.

7.3 STATUTORY PROVISIONS

ADEQ is the agency primarily responsible for regulating water quality. The Department also has some limited responsibilities in this area. Statutory provisions pertaining to the Department's limited authority to regulate groundwater quality are discussed below.

The Code grants the Department authority to regulate groundwater. Under the Code, the Department has the following authority and responsibilities relating to water quality:

- "[T]he director may ... [f]ormulate plans and develop programs for the practical and economical development, management, conservation and use of surface water, groundwater and the watersheds in this state, including the management of water quantity and quality." A.R.S. § 45-105(A)(1).

- "[T]he director may ... [c]onduct feasibility studies and remedial investigations relating to groundwater quality and enter into contracts and cooperative agreements under § 104 of the comprehensive environmental response, compensation, and liability act [CERCLA] of 1980 (P.L. 96-510) to conduct such studies and investigations." A.R.S. § 45-105(A)(16).

- For the third management period, the director "shall, in cooperation with the department of environmental quality, include in each [management] plan an assessment of groundwater quality in the active management area and any proposed program for groundwater quality protection. Any such program shall be submitted to the Legislature for any necessary enabling legislation or coordination with existing programs of the department of environmental quality." A.R.S. § 45-566(A)(7).

- "[T]he director shall consult with the department of environmental quality on water quality considerations in developing and implementing management plans under this article." A.R.S. § 45-573.

The WQARF legislation, as revised in 1997, expands the Department's role in water quality management. The Department's responsibilities and authority under WQARF, which will be explained in greater detail later in this chapter, include the following:

- "[T]he director of water resources, in consultation with the director of environmental quality, may inspect wells for vertical cross-contamination of groundwater by hazardous substances and may take appropriate remedial actions to prevent or mitigate the cross-contamination ...." A.R.S. § 45-605(A).

- "[T]he director [of water resources] shall notify an applicant for a permit or a person who files a notice of intent to drill a new or replacement well if the location of the proposed well is within a subbasin where there is a site [with existing or future groundwater contamination presenting a risk of vertical cross-contamination by the well]." The director is also required to adopt rules relating to vertical cross-contamination and new or replacement wells. A.R.S. § 45-605(E).

- "[T]he director of environmental quality and the director of water resources shall coordinate their efforts to expedite remedial actions, including obtaining information pertinent to site investigations, remedial investigations, site management and beneficial use of remediated water." A.R.S. § 49-290.01(C).

- The director of water resources may waive permits, approvals or authorizations if they "unreasonably limit the completion of a remedial action." A.R.S. § 49-290.01(A). The director of water resources may also waive any regulatory requirement under title 45 if the requirement conflicts with the selected remedy in a remedial action as long as the waiver does not "result in adverse impacts to other land and water users." A.R.S. § 49-290.01(D).

- "The department of water resources shall include in its management plans ...provisions to encourage the beneficial use of groundwater that is withdrawn pursuant to approved remedial action projects ...." Laws 1997, Ch. 287, § 51. In order to encourage the beneficial use of remediated groundwater, "the department of water resources shall account for groundwater withdrawn pursuant to approved remedial action projects under CERCLA or title 49, Arizona Revised Statutes, consistent with the accounting for surface water" for purposes of determining compliance with management plan conservation requirements. Laws 1997, Ch. 287, § 51(B).

- "For each calendar year until 2025, the use of up to an aggregate of sixty-five thousand acre-feet of groundwater withdrawn within all active management areas pursuant to approved remedial action

projects under CERCLA or title 49, Arizona Revised Statutes, shall be considered consistent with the management goal of the active management area as prescribed in section 45-576, subsection I, paragraph 2, Arizona Revised Statutes." Additionally, in the third management period, fifty percent of the total volume of groundwater withdrawn pursuant to remedial action projects and in excess of the aggregate volume of sixty-five thousand acre-feet shall be considered consistent with the management goal of the AMA. Laws 1997, Ch. 287, § 52.

- "The department of environmental quality and the department of water resources shall develop a method of sharing data, including cooperative data base development and integration between the departments, that will provide the departments with the information necessary to protect the resources of the state." Laws 1997, Ch. 287, § 53.

- "The directors of environmental quality and water resources shall enter into an agreement to coordinate the well inspection and remediation programs and to rank wells within an area of contamination according to each well's potential to act as a conduit to spread contamination and to determine the appropriate remedial action regarding the wells with a potential to act as a conduit, including well reconstruction, well abandonment or no action." Laws 1997, Ch. 287, § 54.

7.4 THE REGULATION OF GROUNDWATER QUALITY IN ARIZONA

To understand the Department's role in regulating groundwater quality, it is important to understand the broad framework of laws and programs impacting both groundwater and surface water quality. Since groundwater quantity and quality issues are so interrelated, ADEQ and the Department work together to prevent and mitigate groundwater quality and quantity problems. ADEQ has the lead role in protecting the State's groundwater and surface water quality, while the Department secondarily manages groundwater quality concerns. This section will discuss the regulatory agencies responsible for administering laws impacting groundwater and surface water quality as well as the federal laws and state programs impacting groundwater quality and secondarily surface water quality.

7.4.1 Water Quality Regulatory Agencies

Water quality protection programs in Arizona are based on both federal and state law and are primarily administered by either ADEQ or the United States Environmental Protection Agency (EPA) Region IX. ADEQ has the responsibility to administer state water quality programs pursuant to state statutes and to administer federal water quality programs for which the EPA has delegated its authority to the state, sometimes referred to as state primacy. EPA has the responsibility to administer federal water quality programs pursuant to federal statutes but delegates its authority to states where the state demonstrates that it can adequately administer the program and the federal statute provides for the delegation of authority to states.

ADEQ has authority pursuant to the Environmental Quality Act (EQA) of 1986 (A.R.S. § 49-101 *et seq.*) to set water quality standards and to regulate discharges that have the potential to impact the quality of groundwater by requiring that discharges are subject to aquifer protection permits (APP). ADEQ has authority under the Clean Water Act (CWA) to set Arizona's surface water quality standards and to certify that discharges subject to federal permits do not violate state water quality standards.

EPA Region IX retains authority to administer the CWA National Pollutant Discharge Elimination System (NPDES) permits and the pretreatment program, while the United States Army Corps of Engineers (Corps), Los Angeles District, has authority to administer CWA permits for the discharge of dredge or fill materials in Arizona's waters. EPA Region IX also has authority to require groundwater monitoring and remediation in accordance with CERCLA.

7.4.2 Federal Laws Impacting Groundwater Quality

The Safe Drinking Water Act (SDWA) is the primary federal law regulating groundwater quality. In particular, it regulates drinking water which includes groundwater. The CWA, which regulates surface water, also impacts groundwater quality. CERCLA and the Resource Conservation and Recovery Act (RCRA) impact groundwater management through the regulation of hazardous waste and sites contaminated by hazardous waste. Following is a brief overview of these federal laws and their impacts on the Department's water quality management.

7.4.2.1 Safe Drinking Water Act

The Safe Drinking Water Act was enacted in 1974 to regulate drinking water. ADEQ has been delegated authority by the EPA to implement the SDWA and "to ensure that all potable water distributed or sold to the public through public and semi-public water systems is free from unwholesome, poisonous, deleterious, or other foreign substances and filth or disease causing substances or organisms." A.R.S. § 49-351(A).

There are two types of standards set by the SDWA: national primary drinking water regulations and national secondary drinking water regulations. National primary drinking water regulations may either be primary Maximum Contaminant Levels (MCLs) or Treatment Techniques (TT) requirements. Primary MCLs are the maximum permissible level of a constituent in a public water system and constitute the enforceable standard for safe drinking water. TT requirements set action levels for constituents such as lead and copper that cannot be directly detected or removed by water systems. National secondary drinking water regulations, referred to as secondary Maximum Contaminant Levels (SMCLs), set non-enforceable numeric standards for the aesthetic quality of the water, such as taste, odor, or color. Water with contaminants above the SMCLs are not typically expected to cause health problems. ADEQ has adopted the EPA MCLs as state Drinking Water Standards and has the authority to adopt more stringent standards as well.

Although the Department does not directly regulate drinking water quality, the presence of contaminants in groundwater does negatively impact water quality for municipal providers and poses significant water management issues for drinking water systems.

7.4.2.2 Clean Water Act

The CWA, first passed in 1972, is the comprehensive federal statute regulating surface water quality. The CWA contains six major elements: (1) the NPDES permit program which regulates discharges of pollutants by any person to the nations waters and is designed to protect the chemical and biological integrity of the nation's waters, (2) technology-based effluent standards that apply to the quality of a discharge from a facility, (3) state ambient water quality standards, (4) dredge and fill permits designed to protect the physical and biological integrity of the nation's waters, (5) oil and hazardous substance spill liability, and (6) federal grant programs for improvement of municipal water treatment.

Under the NPDES permit program, all point source dischargers of pollutants into "waters of the United States" must obtain a permit. The jurisdictional reach of the CWA extends to "navigable waters" which are defined as "waters of the United States, including the territorial seas." 33 U.S.C. § 1362(7). EPA and the Corps define "waters of the United States" to include interstate waters; waters which are used, were used in the past, or may be susceptible to use in interstate or foreign commerce; tributaries to such waters; the territorial sea and wetlands. 40 C.F.R. §122.2; 33 C.F.R. § 328.3(a). A frequently cited definition of "waters of the United States" is

> any waterway within the United States also including normally dry arroyos through which water may flow, where such water will ultimately end up in public waters such as a river or stream, tributary to a river or stream, lake, reservoir, bay, gulf, sea or ocean within or adjacent to the United States. *U.S. v. Phelps Dodge Corp.*, 391 F. Supp. 1181 (D. Ariz. 1975).

Based on this "tributary rule," the CWA has potential application to dry land which drains into a water of the United States. Additionally, EPA interprets waters of the United States to include wetlands, areas susceptible to use as habitat by migratory wildfowl, and areas where industries engaged in interstate commerce discharge. 44 Fed. Reg. 32854, 32858 (June 7, 1979); 51 Fed. Reg. 41206, 41217 (Nov. 13, 1986). "Point source" means:

> any discernible, confined and discrete conveyance including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation or vessel or other floating craft, from which pollutants are or may be discharged. 33 U.S.C. § 1362(11).

"Pollutant" includes dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal and agricultural waste discharged into water. 33 U.S.C. § 1362(6). Based on the expansive definitions of "waters of the United States," "point source" and "pollutant," the jurisdictional reach of the CWA NPDES program is quite broad. EPA has also implemented a NPDES storm water permit program that regulates municipal and industrial runoff which eventually discharges to waters of the United States.

NPDES permits that allow discharges to canals or river systems as a result of remedial projects or by wastewater treatment facilities are important to the Department's overall water management strategy. As a result, the Department provides input on related reports and draft NPDES permits that may impact the water management activities in the state. Furthermore, non-point source contamination of groundwater by such substances as nitrate, sulfate, and dissolved solids can render large volumes of groundwater unusable for many purposes and pose serious water management problems. Therefore, the Department monitors statutory and programmatic developments as well as permits and reports related to non-point source discharges under the CWA.

The Clean Water Act also provides for area-wide, long-range planning processes to mitigate water quality control problems in selected areas which result from urban and industrial wastewater. Because such planning processes provide a comprehensive review of wastewater treatment and reuse options, the Department participates in such plans and amendments and provides technical assistance to local councils of government who administer the plans.

7.4.2.3 Comprehensive Environmental Response, Compensation and Liability Act

CERCLA and the Superfund Amendments and Reauthorization Act, commonly referred to as the federal Superfund program, authorize investigation and remediation of groundwater contaminated by releases of hazardous substances. Groundwater remediation may be required to comply with MCL standards, although less stringent standards may be approved by EPA on a case-by-case basis through a technical waiver process. In Arizona, CERCLA establishes a comprehensive response program which is administered by ADEQ in cooperation with the EPA. The Department also plays an advisory role in this process.

Under Section 105 of CERCLA, the EPA is required to annually update the National Priorities List (NPL) of Superfund sites. The sites are proposed for inclusion on the NPL after being assessed as to the release

of hazardous substances that threaten public health and the environment. Two significant components in the Superfund process are site investigation (Remedial Investigation) and evaluation of possible cleanup alternatives (the Feasibility Study). During the Remedial Investigation, information is gathered to determine the general nature, extent, and sources of contamination at a site. Once the final cleanup plan has been selected, EPA formalizes this decision by signing a "Record of Decision" (ROD). The ROD also contains a Responsiveness Summary which is EPA's response to public comments on the Remedial Investigation, Feasibility Study, and Proposed Plan. Design and actual cleanup activities (Remedial Design and Remedial Action) can then proceed.

The Department regularly participates in the CERCLA program activities, primarily for sites located within AMA boundaries. The Department's concern at CERCLA sites is that any groundwater that is withdrawn and remediated be put to reasonable and beneficial use. The Department participates on CERCLA technical committees and serves in an advisory capacity for monitoring and extraction well installation, source control projects, and permitting.

7.4.2.4 Resource Conservation and Recovery Act

RCRA established a national hazardous waste management program in 1976. Under RCRA, hazardous waste permits are issued for the treatment, storage, and disposal (TSD) of hazardous wastes. Individual permits issued to these facilities specify design, performance, and operational standards which include groundwater monitoring. Hazardous waste facilities also undergo a closure process once operations are reduced or terminated. Moreover, corrective action may be required at TSD facilities and may include groundwater monitoring.

ADEQ has been delegated authority for the implementation of RCRA requirements in Arizona. The Department's participation at RCRA sites is important for water management activities, particularly in regard to well siting, use permits, and end use issues.

7.4.3 ADEQ Programs that Impact Department Groundwater Quality Activities

The EQA established the ADEQ and created a strong and comprehensive water quality management structure. ADEQ's programs that protect groundwater resources include water quality assessments, groundwater monitoring, pollutant discharge, permitting activities, and remediation activities. The following are selected water quality protection programs which fall under the jurisdiction of ADEQ and have a direct impact on Department activities.

7.4.3.1 Aquifer Water Quality Standards

Arizona's Aquifer Water Quality Standards (AWQSs) are the cornerstone of the State's groundwater protection program. Arizona has adopted the federal primary MCLs, established under SDWA, as numeric AWQSs. A.A.C. R18-11-406. These standards apply to aquifers classified and protected for drinking water use. Because all aquifers in Arizona are classified and protected for drinking water use, Arizona's AWQSs are enforceable standards for water quality in all of Arizona's aquifers. A.R.S. § 49-224(B).

ADEQ may reclassify an aquifer within an AMA, upon consultation with the appropriate Groundwater Users Advisory Council and upon conducting a public hearing, for a projected use other than drinking water if the identified aquifer is hydrologically isolated from the other aquifers or other portions of the same aquifer, water from the identified aquifer is not being used as drinking water, and the benefits to the public of the resulting water quality degradation outweigh the costs. A.R.S. § 49-224(c).

Arizona has also adopted narrative AWQS to regulate pollutant discharges for which no numeric standards have been developed. Arizona's narrative AWQS include the following: (1) a discharge shall not cause a

pollutant to be present in an aquifer classified for a drinking water protected use in a concentration which endangers human health, (2) a discharge shall not cause or contribute to a violation of a surface water quality standard established for a navigable water of the State, and (3) a discharge shall not cause a pollutant to be present in an aquifer which impairs existing or reasonably foreseeable uses of water in an aquifer. A.A.C. R18-11-405.

7.4.3.2 Aquifer Protection Program

The most comprehensive ADEQ groundwater protection program is the APP system, established by the EQA in 1986 and implemented by rule in 1989. An individual or general permit is required for any person who discharges or who owns or operates a facility that discharges a pollutant from a facility either directly into an aquifer or to the land surface or the vadose zone in such a manner that there is a reasonable probability that the pollutant will reach an aquifer. A.R.S. §§ 49-201(11), 49-241. Discharging facilities that require either an individual or general permit to operate include surface impoundments, solid waste disposal facilities, injection wells, land treatment facilities, facilities which add a pollutant to an assortment of salt formations, dry well or underground cave or mine, mine tailings piles and ponds, mine leaching operations, large septic tank systems, effluent recharge projects, point source discharges to waters of the United States and sewage or sludge ponds and waste water treatment facilities. A.R.S. § 49-241(B). Classes or categories of facilities which are exempted from APP requirements are identified in A.R.S. § 49-250. General permits are issued by rule and individual permits must be applied for.

APPs require a demonstration that AWQSs are maintained and the Best Available Demonstrated Control Technology (BADCT) is applied. For individual APPs, compliance with AWQSs is measured at a designated point of compliance. BADCT requirements ensure that the greatest degree of discharge reduction is achieved through an evaluation of site-specific engineering, environmental, and economic criteria.

APPs may require compliance with best management practices (BMPs). BMPs are often site design techniques for the purpose of water quality protection. BMPs may be adopted for on-site facilities for urban runoff, storm sewers, silvicultural activities, and septic tank systems. Agricultural general permits require compliance with BMPs for nitrogen fertilizer application and concentrated animal feeding operations. ADEQ is required to monitor compliance with the established BMPs and to measure BMPs effectiveness.

Department staff receives and reviews all APPs for any impacts on Departmental programs and water management. In particular, the Department coordinates with ADEQ to review APP applications for potential harmful water quality impacts on groundwater conditions. Pursuant to A.A.C. R18-9-109, ADEQ advises the Department of each APP application received for a facility that is a recharge project or an underground storage and recovery project. One of the conditions for the issuance of an underground storage facility permit is that ADEQ must determine that the facility is not in a location which will result in pollutants being leached to the groundwater table so as to cause unreasonable harm. A.R.S. § 45-811.01(C). Facilities exempt from APP provisions may instead be required by the Department in consultation with ADEQ to meet other requirements to mitigate harmful water quality impacts to the aquifer.

7.4.3.3 Wellhead Protection Program

An important addition to Arizona's groundwater protection program has been the development of the Wellhead Protection Program which fulfills federal requirements of section 1428 of the SDWA by designating Wellhead Protection Areas around public drinking water systems. The Wellhead Protection Program is a voluntary program which encourages the protection of all wells, not just public drinking water

system wells. Local entities that have the authority to control land use and exercise other management options can implement wellhead protection, therefore encouraging the creation of local programs.

7.4.3.4 Reuse Permits

Reuse permits are issued to facilities which provide wastewater for reuse. A reuse permit specifies the amount of effluent to be reused and its chemical quality. ADEQ wastewater reuse rules (A.A.C. R18-9-701 *et seq.*) set the criteria for the use of treated effluent, or reclaimed water, for purposes such as agricultural irrigation, turf irrigation, and recharge. The current reuse rules prescribe numeric reclaimed water quality criteria and monitoring requirements for specific reuse applications. In general, these rules prescribe allowable limits for pH, total fecal coliform, turbidity, enteric viruses, and certain parasites. Reuse may be limited depending on the quality of source water and the intended use.

Wastewater reuse rules undergo periodic updating through ADEQ's rule making process. The Department reviews any proposed changes to the wastewater reuse rules to ensure the protection of public health and groundwater supplies while maximizing the use of a significant renewable water supply. The Department evaluates effluent reuse permits issued by ADEQ and encourages the use of treated effluent where appropriate.

7.4.3.5 Underground Storage Tanks

ADEQ's Underground Storage Tank (UST) program was developed to ensure the proper operation of underground storage tanks and to prevent and remediate releases. Under state regulation and RCRA amendments, the UST program consists of notification requirements, technical standards for new and existing USTs, leak detection and closure criteria, corrective actions for remediation, and financial responsibility demonstrations. Leaking USTs in a concentrated area can present detrimental impacts on groundwater quality and supplies.

The Department has the authority to issue poor quality groundwater withdrawal permits for water contaminated by USTs. The Department can provide guidance for UST site remediation projects to ensure the beneficial use of remediated water.

USTs leak volatile organic compounds (VOCs) which could cause a water quality problem if they were to contaminate local aquifers. Prescott's current source of municipal water supply is situated near Chino Valley, which is located a considerable distance away from any leaking UST sources. Migration of VOC plumes is monitored to ensure that potable water supplies are not threatened.

7.4.3.6 Water Quality Assurance Revolving Fund

The WQARF Program, sometimes referred to as the state Superfund program, was created as part of the EQA. WQARF monies are used to protect the waters of our state against hazardous substances, and may be used in conjunction with federal funds. Funds can be used for statewide water quality monitoring, health and risk assessment studies, and remediating hazardous substances which threaten the waters of the state. Mitigation of non-hazardous substances is also allowed under specified conditions. A.R.S. § 49-286. Each year, ADEQ develops a list of environmentally threatened sites which qualify for WQARF monies. Funds are used at those sites to mitigate existing contamination or to prevent further spread of pollutants which may threaten Arizona's water supplies. A priority list is developed by ADEQ based on such things as the degree of risk to the environment and other available funding sources.

Some of the key legislative changes made in the 1997 WQARF reform package include: establishment of a proportional share liability for cost allocation to responsible parties; creation of the neutral party arbitration process, with incentives to encourage early settlements, and disincentives to responsible parties

which do not enroll in the neutral party arbitration process; new ADEQ funding mechanisms designed to protect existing wells against migrating contamination from WQARF sites; the creation of a comprehensive WQARF site registry, which consolidates a number of separate lists which were previously used; the inclusion of petroleum releases in the WQARF Program under some circumstances; and increased flexibility in the selection of groundwater remedies.

ADEQ follows a process for management and cleanup of WQARF sites that consists of site identification and characterization, site prioritization, remedy selection, identification of end uses, implementation and monitoring, and closure. The criteria to be used in evaluation of response actions include practicability, risk, cost, and benefit. This process also includes a comparison of alternatives based on established statutory criteria, developing a Remedial Action Plan, providing public comment, and issuing a Record of Decision. The Department of Water Resources will actively coordinate with ADEQ in the planning and implementation of groundwater cleanup actions under WQARF.

7.4.3.7 Water Infrastructure Finance Authority

In 1989, the Arizona Legislature created the Wastewater Management Authority to administer funds granted to the state pursuant to the federal SDWA. These funds, which required a 20 percent state match, were loaned to wastewater treatment systems in the state for assistance in meeting requirements of the SDWA. ADEQ made loans for this purpose from monies in the ADEQ wastewater treatment revolving fund.

In 1997, this administrative body was amended by the Legislature and renamed the Water Infrastructure Finance Authority (WIFA). The authority for WIFA was expanded to make loans available to drinking water systems in addition to wastewater treatment systems for assistance in meeting requirements of the SDWA. The state funding source was also changed so that monies made available to these systems are now derived from the drinking water revolving fund. The Department participates on the advisory board which oversees the WIFA and has an interest in viability of water systems and SDWA compliance.

7.4.4 Department of Water Resources Programs Related to Groundwater Quality

The Department protects groundwater quality by considering groundwater quality issues in its permitting process and water quantity management programs. As a result of WQARF reform legislation of 1997, the Department has increased its responsibility in the program to coordinate and provide assistance to WQARF activities. Among other things, the bill provides for:

- annual funding for Department WQARF activities,
- database development and coordination with ADEQ,
- groundwater withdrawn pursuant to certain cleanups to be accounted for in the same manner as surface water for the purpose of determining compliance with conservation requirements,
- amendment of the Assured Water Supply Rules,
- active involvement by the Department in all phases of site assessment, remediation, management, operation, and planning strategies,
- a WQARF Advisory Board on which the Department has a seat, and
- a well inspection program through which wells that are contributing to vertical cross-contamination may be identified and modified.

The Department's existing permits and programs which involve groundwater quality issues as well as its new programs for groundwater quality protection based on the WQARF legislation are discussed in the following section.

7.4.4.1 Poor Quality Groundwater Withdrawal Permits

Appropriate use of poor quality groundwater conserves the existing supply of potable groundwater. The Department issues poor quality groundwater withdrawal permits to allow the withdrawal of groundwater which, because of its quality, has no other beneficial use at the present time. A.R.S. § 45-516. Withdrawal permits are issued by the Department, and the withdrawal must be consistent with the AMA management plan. Permits are usually issued in conjunction with CERCLA, WQARF, or leaking UST sites for pump and treat operations. To increase the appropriate uses of poor quality groundwater during the third management period, the Department continues to encourage matching poor quality groundwater with beneficial uses within the AMA.

7.4.4.2 Assured Water Supply

The Assured Water Supply Program (AWS Program) is a consumer protection program that ensures that new subdivisions have a secure supply of water with adequate quality for at least 100 years. Pursuant to A.R.S. § 45-576, before land may be subdivided, the developer of the property must either obtain a Certificate of Assured Water Supply for the subdivision from the Department, or must establish the development as a customer of a municipal water provider that the Department has designated as having an assured water supply.

Pursuant to rules governing the AWS Program set forth at A.A.C. R12-15-701 *et seq.*, in order to establish an assured water supply, the applicant must prove that a supply of water is physically, legally, and continuously available for the 100-year period to meet the demands of the development that will be the subject of the certificate, or in the case of a designation, to meet current and committed demands of the water provider for the 100-year period. The applicant must also establish that projected water use will be consistent with achievement of the management goal for the active management area and that the applicant has the financial capability to construct the physical facilities necessary to serve the development. In addition, the applicant must establish that the water supply pledged for assured water supply purposes is of adequate quality.

In assessing the quality of a groundwater supply pledged for assured water supply purposes, the Department works closely with ADEQ to determine whether the groundwater supply meets ADEQ standards for the purposes for which the water is pledged. If the groundwater is not of adequate quality, the applicant may need to find alternative water sources or to expend additional resources treating the groundwater to meet the ADEQ standards.

7.4.4.3 Underground Water Storage and Recovery

Underground water storage, also known as recharge, will play an important role in achieving the Prescott AMA's goal of safe-yield. Recharge projects will store surface water that is currently not used directly. Credits for recharged surface water will then be available to water providers and developers to establish an assured water supply. In addition, recharge of effluent can be used as a tool to allow more complete use of that resource.

The underground water storage program is administered by the Department. Permits must be obtained from the Department prior to undertaking recharge activities. The Department coordinates closely with ADEQ to ensure that underground water storage does not adversely impact existing aquifer water quality and does not cause movement of existing groundwater contamination. If effluent is stored underground, the applicant must obtain an APP from ADEQ, in addition to the underground storage permits required from the Department.

The City of Prescott currently has an Underground Storage Facility Permit and two Water Storage Permits for the Prescott Airport effluent recharge facility. The water may be recovered pursuant to the City's Recovery Well Permit, which allows the City to recover 1,600 acre-feet of recharged effluent annually. Additionally, about 1,500 acre-feet of recharged surface spill at Watson and Willow Lakes may be recovered once water storage and recovery well permits are issued. See Chapter 8 for a more detailed discussion of the Department's underground water storage and recovery program.

7.4.4.4 Well Spacing/Impact Analysis

A.R.S. § 45-598 and the Department's temporary Well Spacing and Well Impact Rules are in place to prevent unreasonable damage to surrounding wells as well as land and water users due to new wells and new withdrawals of groundwater in an AMA. Specifically, these laws require well impact studies to evaluate the potential for new non-exempt wells and new withdrawals to damage land and other water users, particularly existing wells. The Department conducts the impact studies for wells with a maximum discharge of 500 gallons per minute (gpm) or less. For wells with a maximum discharge rate exceeding 500 gpm, the permit applicant must submit a hydrological study of projected water level declines due to the operation of the proposed well. The study must also assess adverse impacts from the migration of poor quality groundwater. The well permit application may be denied if the Department determines that the proposed well would cause an unreasonable and adverse impact on surrounding wells, additional regional land subsidence, or migration of poor quality groundwater.

7.4.4.5 Well Construction and Abandonment Requirements and Licensing of Well Drillers

If wells are not constructed, sealed, or abandoned properly they can act as conduits for contaminant flow from the surface to groundwater or between aquifers. Improperly constructed wells can contribute to groundwater contamination. The Department's rules governing well construction, abandonment, and driller licensing, set forth at A.A.C. R12-15-801 *et. seq.,* are summarized below.

- Minimum well construction and abandonment requirements prevent entry of fluids at and near the surface and minimize the possibilities of migration and inadvertent withdrawal of poor quality groundwater. These requirements also prohibit the use of hazardous materials in the construction of wells.

- Installation, modification, abandonment, or repair of all wells in Arizona must be performed by a driller licensed by the Department. The licensing procedure includes the administration of written examinations to test the applicant's knowledge of state regulations, hydrologic concepts, and well construction principles and practices.

- Disposal site restriction prevents the use of wells as disposal facilities for any material that may pollute groundwater.

- Special standards may be required by the Department if the minimum well construction requirements do not adequately protect the aquifer or other water users.

- Open wells must be capped with a water-tight steel plate.

- Except for monitor and piezometer wells, no well shall be drilled within 100 feet of any septic tank system, sewage disposal area, landfill, hazardous waste facility or storage area, or petroleum storage areas and tanks, unless authorized by the director.

Wells drilled prior to the enactment of the well construction rules (effective March 5, 1984) were not required to be constructed in accordance with minimum well construction standards. If a pre-rule well is

replaced or modified, however, the new or modified well must meet the current well construction standards. See A.R.S. § 45-594.

7.4.4.6 The Department's Role in the WQARF Program

The Department's involvement in groundwater remediation has been redefined as a result of the Groundwater Task Force, which conducted an extensive series of stakeholder negotiations designed to promote groundwater cleanup and groundwater quality management activities of remedial sites. Involvement in this development process was widespread and representative of a varied group of private and public interests.

7.4.4.6.1 Department Activities in the WQARF Site Cleanup and Management Process

ADEQ's WQARF site cleanup and management process and the Department's role in that process are described in the following discussion.

Site Identification and Characterization

Existing WQARF sites have been identified and are being managed by ADEQ. Additional sites may be identified in the future based on a preliminary investigation by ADEQ to determine the potential risk to public health, welfare, or the environment. The Department will further assist ADEQ in this process by providing resource data which includes well location and pumpage records, water rights information, and any other appropriate data recorded by the Department.

Characterization of sites is important because the nature and extent of contamination must be understood before remedies can be selected and implemented. An important part of site characterization is an evaluation of how contamination impacts current and future groundwater uses. The Department's role may include such activities as site inspections and evaluations, review of investigations, field work such as well inspection and water quality sampling, identification of potential water management issues, and any other characterization as appropriate. Department computer models may be useful in characterizing groundwater flow patterns.

Site Prioritization

The results of the preliminary investigation will be used by ADEQ for site scoring using a method to be established in rules adopted by the director of environmental quality. The completed preliminary investigation will be used by ADEQ to either make a determination of no further action on a site, or to prepare the site for inclusion on the Site Registry. In this latter case, a Site Registry report is prepared containing a description of the site, with its geographical boundaries indicated, and a score in accordance with the site scoring method to be established in rules and adopted by the ADEQ. The Department will assist ADEQ by sharing pertinent water resource information as described in the previous sub-section.

Remedy Selection

ADEQ has established a list of response actions to be considered when managing a site. Based on the potential impact on current and future water uses, a potential remedy must be evaluated and designed. Each remedy is site-specific. The Department will assist in defining potential remedies to ensure that the remedy is consistent with Department management plans and sound groundwater management practices that are publicly acceptable. Ultimately, the Department's level of assistance will vary based on the remedy selected. Possible remedies are discussed below.

- Plume Remediation

Plume remediation, or aquifer restoration, means achieving appropriate water quality standards for groundwater throughout the affected area. Source control and monitoring will likely be essential elements of this strategy. This remedy may be more effective for smaller plumes which can be remedied within reasonable time frames.

- Physical Containment

Physical containment refers to an approach that contains contaminants within defined boundaries. This strategy could consist of plume control and coordination of groundwater pumpage and recharge to ensure that contamination is confined within a defined area. Source control and monitoring are also likely elements of this strategy. Physical containment may be appropriate where potable water supplies are threatened by contaminant migration and where containment is technically feasible, but it may require extensive groundwater management to implement.

- Controlled Migration

This strategy aims to control but not necessarily contain migration of contaminants. Source control and monitoring are likely elements of this strategy. Control of contaminants can include control and/or coordination of pumpage that affects contaminant migration and any other measures taken to control contaminant migration. Controlled migration may be appropriate for larger plumes which cannot be practically remedied or contained.

- Source Control

Source control is reduction of continuing contaminant sources such as soil contamination or areas of high concentrations of volatile organic compounds (VOCs) or other contaminants. Dense non-aqueous phase liquids (DNAPLs), which are contaminants (such as VOCs) of such high concentrations that they are not dissolved in groundwater but exist as free phase liquids, are an example of contaminant sources. Source control is a remedial action that often results in the highest volume of contaminants removed per unit cost.

This strategy employs controlling the pollutant at the source to ensure that aquifer contamination does not continue due to uncontrolled contaminant releases. Monitoring is a likely component of this strategy. Source control can include, but is not limited to, the mitigation of sorbed or free phase contaminants, pumpage of groundwater to contain or control significant sources of contaminants, and the removal of contributing contaminant sources.

- Monitoring

The monitoring remedy involves monitoring instead of other remedy options. Monitoring sites for water quality and groundwater levels is important to determine the extent of contamination and the effectiveness of remedial activities. The incorporation of computer groundwater models may be used to predict contaminant movement, to monitor well locations, and to develop contingency plans for more aggressive remedies, if necessary.

- No Action

This alternative consists of taking no action at a site. This strategy is normally included as a baseline condition for comparison purposes, but may be a viable alternative in limited cases. Generally, this alternative would only be chosen for sites that are geographically isolated from populated areas, do not pose a significant threat to water supplies, or would be used for comparative purposes to other sites.

Identification of End Uses

The Department is committed to the beneficial use of groundwater withdrawn and treated at WQARF sites, along with other areas that have degraded groundwater quality, and will assist ADEQ with the identification and facilitation of designated end uses for remedial projects. These end uses should be consistent with those determined for existing sites as well as the development of new end uses to match the intended use.

Implementation and Monitoring

The implementation and monitoring phase of a site activity includes construction, startup, monitoring, operation and maintenance, and any other appropriate activities. The Department will assist ADEQ in this phase through the following activities where appropriate: field work, review of groundwater analyses, appropriate accounting for assured water supply determinations and for determining compliance with conservation requirements, and any other appropriate activities.

Site Closure

ADEQ must certify that site goals have been attained in order to discontinue cleanup activities. Department staff assist in evaluation of sites and certification of site closure. The Department assists and may need to identify alternative water sources to replace remediated water when sites are closed.

7.4.4.6.2 Department Policies for WQARF Site Cleanup and Management

In general, site plans should be consistent with the management goal of the AMA in which the site is located. A.R.S. §§ 49-282.06(F); 45-105(B)(4)(c). Therefore, the Department will implement policies during the third management period for the management and cleanup of remedial sites in cooperation with the ADEQ. These policies will ensure that AMA goals are addressed when remedial actions are planned. The Department supports proposed remedial projects when they are appropriate, but believes that remedies must make sense from a groundwater management perspective. The principles which will be used to formulate these policies are described below.

Water should be used consistent with water allocation concepts in Title 45

This policy requires that entities using water withdrawn pursuant to cleanups, whether under CERCLA, WQARF, RCRA, voluntary, or other sites, possess appropriate authorities for the use of groundwater (such as permits or water rights).

The Department supports source control cleanups to protect water sources

Source control, which controls pollution at its source, can be the most cost effective and practicable approach to cleanups. Many wells have been rendered unsuitable for potable use due to migrating contamination. Source control projects to protect wells that are threatened by contaminant migration are generally supported by the Department. Pollution prevention is also a significant component of mitigating contaminant migration.

Any groundwater withdrawn must be put to reasonable and beneficial use

Reasonable and beneficial use of groundwater withdrawn is a policy that applies to all cleanups. Any withdrawals of 100 acre-feet or less annually may qualify for de minimis status and be exempted from beneficial use requirements, but the Department will evaluate de minimis exemptions from this policy on a

case-by-case basis. In the case of leaking UST sites, the Department generally exempts sites that annually pump less than 10 or 15 acre-feet.

Contaminated groundwater represents a resource that will be important

Even if groundwater is contaminated, it represents a resource that can be used for both potable and non-potable uses. Potable uses must meet the state AWQS and federal Drinking Water Standards which govern public consumption of potable water. ADEQ and the Arizona Department of Health Services intend to develop end use standards for non-potable uses that, if implemented, will make large volumes of groundwater usable again. The Department will cooperate in the development of non-potable end use standards and will develop policies for appropriate end uses based on the new standards.

Containment remedies that involve massive groundwater withdrawals to achieve regional groundwater flow control are generally inappropriate and will not be supported by the Department

In some cases, massive groundwater withdrawals of uncontaminated or only slightly contaminated water may be considered to control migration of contaminant plumes or for other purposes. In general, the Department considers these kinds of proposed remedies to be wasteful of groundwater and not very cost-effective.

7.4.4.6.3 Statutory Mandates for the Department's Involvement in the WQARF Program

The 1997 WQARF reform legislation mandates that the Department implement certain water quality programs and provides for expanded Department involvement in water quality management. New Department programs and responsibilities based on the 1997 WQARF reform legislation include the following:

Remediated Groundwater Incentives

The WQARF reform legislation of 1997 directs the Department to include in the management plans developed pursuant to A.R.S. § 45-566 (the Third Management Plans) provisions to encourage the beneficial use of groundwater that is withdrawn pursuant to approved remedial action projects under CERCLA or Title 49, Arizona Revised Statutes. Laws 1997, Ch. 287, § 51(A).

- Remediated Groundwater Incentive for Conservation Requirement Accounting

In order to encourage the beneficial use of remediated groundwater, the Legislature specifically mandated:

> In determining compliance with applicable conservation requirements adopted pursuant to sections 45-566, 45-567 and 45-568, Arizona Revised Statutes, the department of water resources shall account for groundwater withdrawn pursuant to approved remedial action projects under CERCLA or title 49, Arizona Revised Statutes, consistent with the accounting for surface water. Laws 1997, Ch. 287, § 51(B).

- Remediated Groundwater Incentive for Assured Water Supply Accounting

In addition, the WQARF reform legislation of 1997 directs the Department to consider specified amounts of groundwater withdrawn pursuant to approved remedial action projects as consistent with the management goal of the active management area from which it is withdrawn for purposes of the Department's AWS Program. Laws 1997, Ch. 287, § 52. The Legislature mandated that

> For each calendar year until 2025, the use of up to an aggregate of sixty-five thousand acre-feet of groundwater withdrawn within all active management areas pursuant to approved remedial action projects under CERCLA or title 49, Arizona Revised Statutes, shall be considered consistent with the management goal of the active management area. Laws 1997, Ch. 287, § 52(A).

Once the aggregate volume of 65,000 acre-feet of remediated groundwater use by all users in all active management areas is reached in a year, the use of an additional amount of remediated groundwater is consistent with the management goal of the active management area based on a sliding scale. In the third management period, fifty percent of the total volume withdrawn in excess of the 65,000 acre-feet will be consistent with the management goal. Laws 1997, Ch. 287, § 52(B). By the year 2025, the remediated groundwater incentive for assured water supply accounting decreases to zero.

A municipal provider must apply for a remediated groundwater accounting for an assured water supply determination prior to January 1, 2010. The amount of groundwater determined to be consistent with the management goal cannot exceed the amount that the municipal provider is legally obligated to withdraw or use and does not extend beyond 2025. Laws 1997, Ch. 287, § 52(C).

Annual groundwater withdrawals of 250 acre-feet or less that are withdrawn pursuant to an approved remedial action project shall not be debited against the water provider's assured water supply mined groundwater account and shall not be subject to a replenishment obligation. The water provider must notify the Department of its compliance with the exemption. Annual withdrawals of 250 acre-feet or less of remediated groundwater will not count against the 65,000 acre-feet per year total volume. Laws 1997, Ch. 287, § 52(E).

- Coordination with ADEQ in Evaluating Proposed Remedial Actions

Pursuant to A.R.S. § 45-105(B)(4)(c), the Department is required to actively coordinate and confer with ADEQ in evaluating proposed remedial actions to provide ADEQ with information regarding water resource considerations. The Department will coordinate and confer with ADEQ prior to ADEQ's approval or denial of a proposed remedial action project. Once a remedial action project is approved by ADEQ or the EPA pursuant to CERCLA or Title 49, Arizona Revised Statutes, the Department will account for remediated groundwater in accordance with Laws 1997, Ch. 287, §§ 51 and 52. Among other things, the Department will consider the following factors relating to proposed remedial actions in its recommendations to ADEQ:

  - Volume of remediated groundwater to be withdrawn

The Department will encourage remedial actions that use the least amount of groundwater necessary to facilitate a project's remedial goal and will discourage remedial actions that are not prudent and efficient from a groundwater management perspective.

  - End uses to which remediated groundwater will be put

The Department will encourage end uses that minimize groundwater withdrawals and that are consistent with the safe-yield goal because they will result in no change in groundwater storage. Where remediated groundwater cannot be practicably or cost-effectively re-injected or recharged, the Department will encourage replacing existing groundwater uses with remediated groundwater and preventing new permanent uses which would not have occurred without the incentive to use remediated groundwater and which would continue to rely on groundwater after the remediated groundwater is no longer available.

While individualized circumstances will be evaluated on a case-by-case basis, generally, the Department's beneficial end use preferences are the following, listed in order from most to least preferred based on the impact on the active management area's management goal and the amount of groundwater in storage:

Neutral to local aquifer

a. Re-inject or recharge in the same local area.
b. Replace existing groundwater uses in the same local area.

Neutral to groundwater basin

c. Re-inject or recharge in the same active management area.
d. Replace existing groundwater uses in the same active management area.

Reduce groundwater in storage

e. Replace existing non-groundwater use in the same active management area.
f. Beneficial uses of water for new purposes.
g. Artificial wetlands or artificial lakes.
h. Dispose to the sewer (unless the resulting effluent is re-injected, recharged or replaces an existing groundwater use).

- Achievement of maximum beneficial use of waters and viability of proposed remedial action

Remedial actions must assure the protection of public health and welfare and the environment; to the extent practicable, provide for the control, management or cleanup of hazardous substances so as to allow the maximum beneficial use of the waters of the state; and be reasonable, necessary, cost-effective, and technically feasible. A.R.S. § 49-282.06(A).

- Consistency with Title 45

Groundwater withdrawn pursuant to an approved remedial action must be withdrawn and used consistent with Title 45, Arizona Revised Statutes.

Well Inspection, Modification or Replacement

The Department is required by the 1997 WQARF legislation to develop rules for well inspections. An evaluation of the extent of the cross-contamination problem will be performed by the Department in cooperation with ADEQ and other stakeholders.

Construction of New Wells In and Near WQARF Sites

The 1997 WQARF legislation mandates that the Department ensure that new or replacement wells in areas of known groundwater contamination are constructed in such a manner that cross-contamination does not occur. Department staff will screen Notices of Intent to Drill that are submitted to ensure that wells are properly constructed. The Department will establish policies and procedures to implement this directive, including procedures to effectively communicate with well owners and drillers.

Abandonment of Wells In and Near WQARF Sites

Department staff will review and evaluate Notices of Intent to Abandon to ensure that abandonment of wells is done in accordance with Department rules and that potential for cross-contamination is minimized.

7.5 WATER QUALITY ASSESSMENT

A water quality assessment must be included in management plans pursuant to the Code. The assessment provides an overview of water quality concerns in the Prescott AMA. The following section discusses goals and objectives of the assessment, water quality of renewable and groundwater supplies, the constituents of concern in the Prescott AMA and their impact on water management, and specific contamination areas in the Prescott AMA.

7.5.1 Assessment Goals and Objectives

The primary goal of the Water Quality Assessment is to provide a general evaluation of groundwater and surface water quality conditions in the Prescott AMA and to identify the interface of water quality concerns with the regional water supply. The impact of water quality on water resource management has become more important in recent years due to such factors as stringent water quality standards, conjunctive use of water supplies, groundwater management at remediation sites, and increasing levels of public concern.

The municipal, agricultural, and industrial sectors have distinctive demand patterns and requirements for water quality. For example, state law prohibits direct use of treated effluent for potable use, but treated effluent is used for turf irrigation, agricultural irrigation, cooling towers, and groundwater recharge. Water that is high in total dissolved solids may be inappropriate for agricultural irrigation but may be usable for some industrial applications. Conversely, water that is high in nitrate could provide a good end use for agriculture, but does not meet potable standards. During the third management period, the Department will evaluate the matching of water quality characteristics with appropriate end uses while ensuring compliance with applicable laws and rules for each end use.

7.5.2 Renewable Water Supplies

Renewable water supplies include surface water and effluent. All Central Arizona Project (CAP) water allocations within the Prescott AMA have been sold to the City of Scottsdale and are no longer available to the AMA. The quality of renewable water supplies in the Prescott AMA is discussed in this section.

7.5.2.1 Surface Water

Surface water quality in the Prescott AMA is generally good. Most surface water is stored at Watson and Willow Lakes, where it has been historically diverted downstream from Granite Creek to the Chino Valley Irrigation District for agricultural irrigation. Surface water throughout the Prescott AMA contains total dissolved solids (TDS) levels below 500 mg/l (milligrams per liter). TDS concentrations are generally a good indicator of overall water quality. Other constituent parameters of surface water generally meet applicable water quality standards with appropriate treatment.

7.5.2.2 Effluent

Effluent is defined by A.R.S. § 45-101(4) as "water that has been collected in a sanitary sewer for subsequent treatment in a facility that is regulated pursuant to A.R.S. §§ 49-361 and 49-362. Such water remains effluent until it acquires the characteristics of groundwater or surface water." Sanitary sewers are comprised of any pipe or other enclosed conduit that carries any waterborne human wastes from residential, commercial, and industrial facilities. A.R.S. § 45-101(8).

Effluent treated at municipal wastewater treatment plants is a significant source of renewable water supply in the Prescott AMA. Although not suitable for human consumption without advanced treatment, effluent is suitable for turf irrigation, agricultural irrigation, sand and gravel washing, and several other industrial applications. Wastewater reuse rules are developed by ADEQ and establish parameters for wastewater

reuse options. Wastewater discharges require a NPDES permit to ensure that water quality parameters are being met.

The City of Prescott operates two facilities in the Little Chino Subbasin, the Sundog and Prescott Airport wastewater treatment plants. Treated effluent from the Sundog facility was originally discharged into Watson Lake. This practice was discontinued in 1985, because at that time, NPDES standards would have required further treatment of the effluent prior to discharge that was considered cost-prohibitive. Subsequently, effluent from both facilities is either delivered for irrigation purposes to Antelope Hills Golf Course, or is recharged on-site at the Prescott Airport facility through infiltration basins. Another wastewater treatment plant is operated by the Town of Prescott Valley in the Agua Fria Subbasin, where treated effluent is discharged into the Agua Fria River pursuant to a NPDES permit.

Constructed wetlands may be developed to further enhance the treatment of effluent and pre-treat water prior to recharge or reuse. Vegetation and microbial activity in wetlands as well as filtration of effluent through the vadose zone (soil aquifer treatment) improve the quality of water containing high concentrations of nitrate and organic carbon. Constructed wetlands are occasionally used as a treatment for lower quality surface waters and agricultural return flows. Wetland projects are also being evaluated as enhanced treatment for effluent discharges to meet potentially more stringent NPDES permit requirements. Wetlands also enhance wildlife habitat and serve as an educational and recreational resource for the community.

7.5.3 Groundwater Supplies

Groundwater is one of the most important sources of water in Arizona. Most of the groundwater in the Prescott AMA is of acceptable quality for most uses. However, some aquifers have been degraded as a result of contamination.

The introduction of contaminants into aquifer systems degrades groundwater quality and threatens public health and the environment. Contaminants can migrate into areas of potable groundwater due to groundwater pumping or regional groundwater flow patterns. Many areas of the Prescott AMA are projected to remain dependent on groundwater pumping, thereby potentially causing migration of contaminants. The Department's role in managing potential contaminant migration is through involvement in site-specific and non site-specific water quality management.

Groundwater that has been degraded has limited beneficial uses due to chemical, biological, or radiological contamination and may have high treatment and delivery costs associated with its use. Despite these limitations, the Department considers poor quality groundwater to be a valuable resource for future water management and encourages appropriate uses of this water supply. Matching the highest beneficial use with poor quality groundwater is an important aspect of water management. Frequently, poor quality groundwater is remediated and reinjected into the aquifer because it is not economically feasible to convey the treated water to a location for a higher beneficial use.

Recognizing that there may be groundwater quality impacts resulting from surface water recharge, the EPA requires states to develop a rule for groundwater under the influence of surface water. ADEQ has proposed a rule (A.A.C. R18-11-405), currently under public review, which would require that groundwater under the direct influence of surface water withdrawn from recharge facilities undergo more extensive treatment than groundwater.

7.5.4 Groundwater Constituents and Their Impacts on Water Quality Management

The management of water resources requires an understanding of how water quality impacts aquifer conditions and potential uses. Drinking water quality regulations are developed to ensure that the intended

use will not have harmful impacts on human health. The Department and ADEQ evaluate water quality based on ADEQ's numeric and narrative AWQSs as well as EPA's MCLs and SMCLs, commonly expressed as mg/l or micrograms per liter (µg/l). Appendices 7A and 7B provide a more detailed listing of primary and secondary MCLs for selected volatile organic compounds, pesticides, inorganic metals, radiochemicals, and other selected contaminants.

The following sections briefly overview the impact of selected constituents on groundwater management and public health. ADEQ's Arizona Water Quality Assessment was used as a reference to describe the limitations on uses, present and planned remedial activities, and potential uses for poor quality groundwater for each constituent.

For each constituent, a corresponding map is provided which displays available water quality data for well locations sampled in the Prescott AMA since 1990. Well sites that produced test results within acceptable water quality standards are displayed in addition to those well locations which exceeded standards. The groundwater quality maps developed for the constituents depicted on these maps were the result of an interagency effort between the Department and ADEQ. An interagency team retrieved and analyzed data from a variety of sources including the Department's Registry of Groundwater Rights and Groundwater Site Inventory databases, the ADEQ Groundwater Quality database, and a number of WQARF site project reports.

Other ADEQ databases, such as the UST and Drinking Water Quality databases, were not used because they either did not have compatible well registration identification numbers from which to compare each agency's well information, or they contained non-point source information which cannot be assigned to a specific location such as a well. Consequently, the groundwater quality maps depicted in this section are a product of the practical information available that is compatible with the Department's well identification system and from which both agencies had a high level of confidence in the data presented. The groundwater quality maps provide a general overview of water quality conditions within the AMA. Other reports which are published by ADEQ may contain additional data which are not reflected on these maps.

7.5.4.1 Nitrate

Nitrates are salts formed from nitrogen compounds and are one of the most common groundwater contaminants detected in Arizona. Low nitrate concentrations in groundwater may originate from natural sources such as organic acids. Elevated nitrate levels are generally attributed to industrial sources, wastewater treatment plants, septic tanks and leach fields, or agricultural fertilizers.

Water containing high levels of nitrate-nitrogen cannot be delivered as a drinking water supply unless it is equal to or reduced below the MCL of 10 mg/l. Adults can tolerate high levels of nitrate-nitrogen, although water containing more than several hundred mg/l can cause gastrointestinal irritation. Water that contains nitrate in concentrations in excess of the MCL can be harmful to infants. Nitrate may also be harmful to livestock at levels exceeding several thousand mg/l.

Nitrate stimulates plant growth and is typically regarded as a desirable constituent under most agricultural and turf irrigated conditions. For this reason, effluent is often sought as a source of irrigation water. Nitrogen fertilizer application rates may be reduced or eliminated if irrigation water contains elevated nitrate levels.

Figure 7-1 displays nitrate well testing data for locations within the Prescott AMA. Groundwater with nitrate concentrations in excess of the MCL of 10 mg/l were found at a few isolated locations in the Upper Agua Fria Subbasin.

7.5.4.2 Sulfate

Sulfate can occur as a natural inorganic constituent of groundwater which originates from the natural dissolution of minerals in aquifers. Elevated concentrations can result from the leaching of industrial wastes and agricultural fertilizers. High sulfate concentrations are often found in aquifers underlying current or historic agricultural lands, mining areas, and areas of natural mineralization.

The EPA has not established a primary MCL for sulfate although it is currently under review. The secondary MCL for sulfate is 250 mg/l. Figure 7-2 illustrates sulfate conditions in the Prescott AMA. Sulfate levels within the Prescott AMA generally do not exceed the secondary MCL.

Elevated sulfate concentrations in drinking water supplies can cause problems due to taste and laxative effects and can lead to scale formation in evaporative cooling systems. The diverse nature of industrial water requirements creates specific water quality needs for different industries. Some industries require very low sulfate levels while others can use water with elevated sulfate levels. Additionally, high sulfate concentrations in groundwater do not commonly limit agricultural water use.

7.5.4.3 Total Dissolved Solids

TDS content is a measure of the dissolved minerals present in water and is a general indication of water quality. Components of TDS include inorganic compounds such as calcium, magnesium, sodium, potassium, sulfate, bicarbonate, chloride, and silica. In most areas, the primary components of TDS are derived naturally as groundwater dissolves minerals present in aquifers. TDS concentrations can also be elevated by agriculture, industry, and wastewater treatment facility discharges.

The EPA has established a SMCL of 500 mg/l for TDS, primarily for aesthetic reasons. High TDS concentrations which result in scaling and mineral accumulation have been shown to have an adverse economic impact on water distribution systems and household plumbing and appliances. Though no permanent harmful effects have been observed from drinking high TDS water, some people may find the taste of this water to be less desirable than lower TDS water.

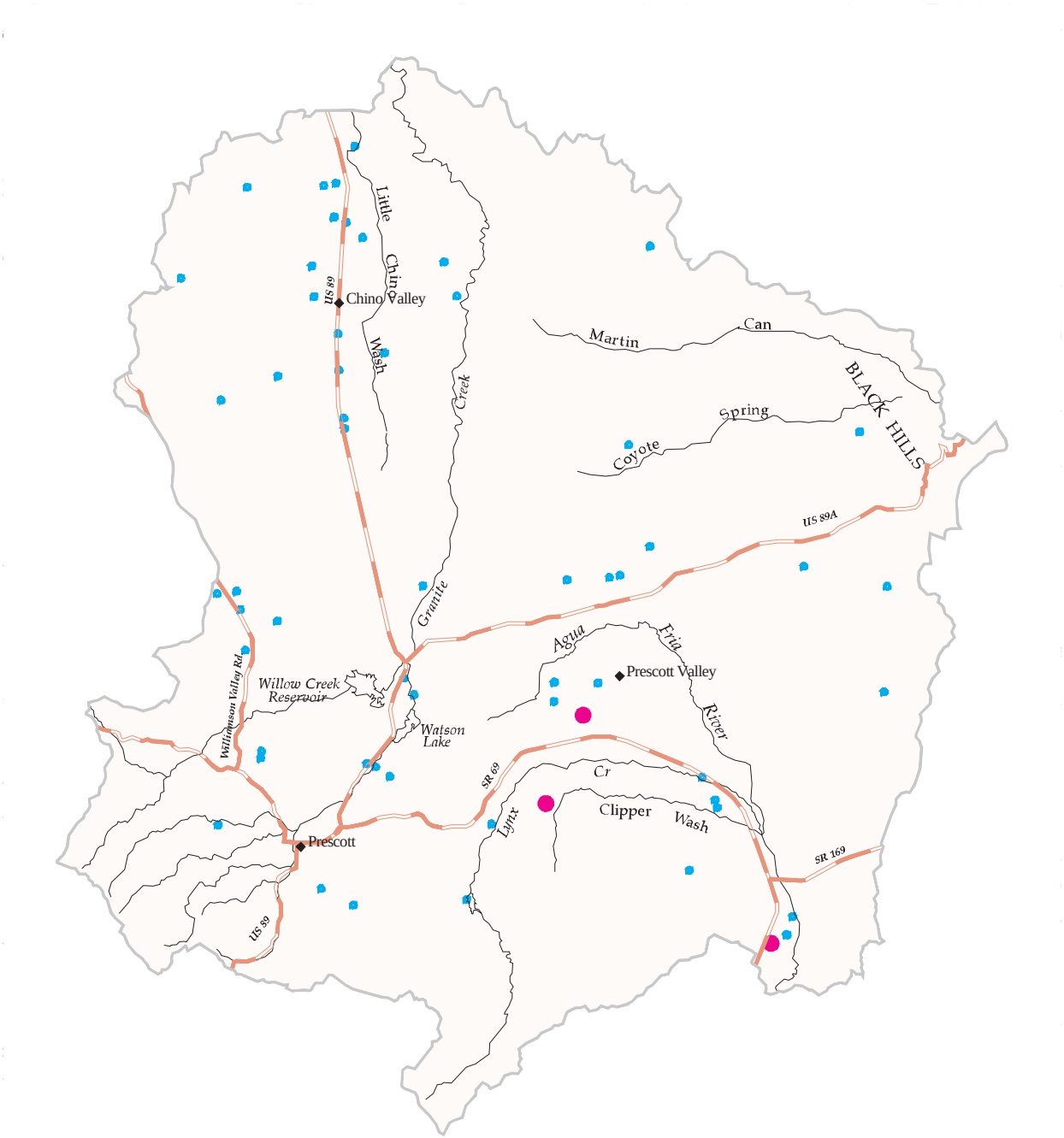
TDS concentrations in the Prescott AMA are depicted in Figure 7-3. TDS concentrations within the Prescott AMA exhibit concentrations of less than 500 mg/l.

The concentration of TDS that limits water use varies widely among industries. A few industries (such as the semiconductor industry) require water so pure that they must treat almost any source water to obtain the necessary quality. Other industries, such as sand and gravel operations, can use water with very high TDS concentrations. The application of high TDS water on turf facilities can cause harmful effects to turf quality and to sprinkler heads if proper management techniques are not followed.

7.5.4.4 Metals

The EPA has established primary MCLs for the following nine metals that occur in drinking water: antimony, arsenic, barium, beryllium, cadmium, chromium, mercury, selenium, and thallium. High concentrations of metals are typically associated with industrial wastes, but certain metals may naturally occur in some aquifers.

Figure 7-4 displays metal concentrations in the Prescott AMA. Metal concentrations in the Prescott AMA have not been detected above MCLs.



Sample Test Results

- 61 points < MCL shown
- 3 points >= MCL shown

Administrative Areas

- Prescott AMA
- Highways and Roads
- Streams
- Cities

Figure 7- 1

Water Quality Sample Test Results

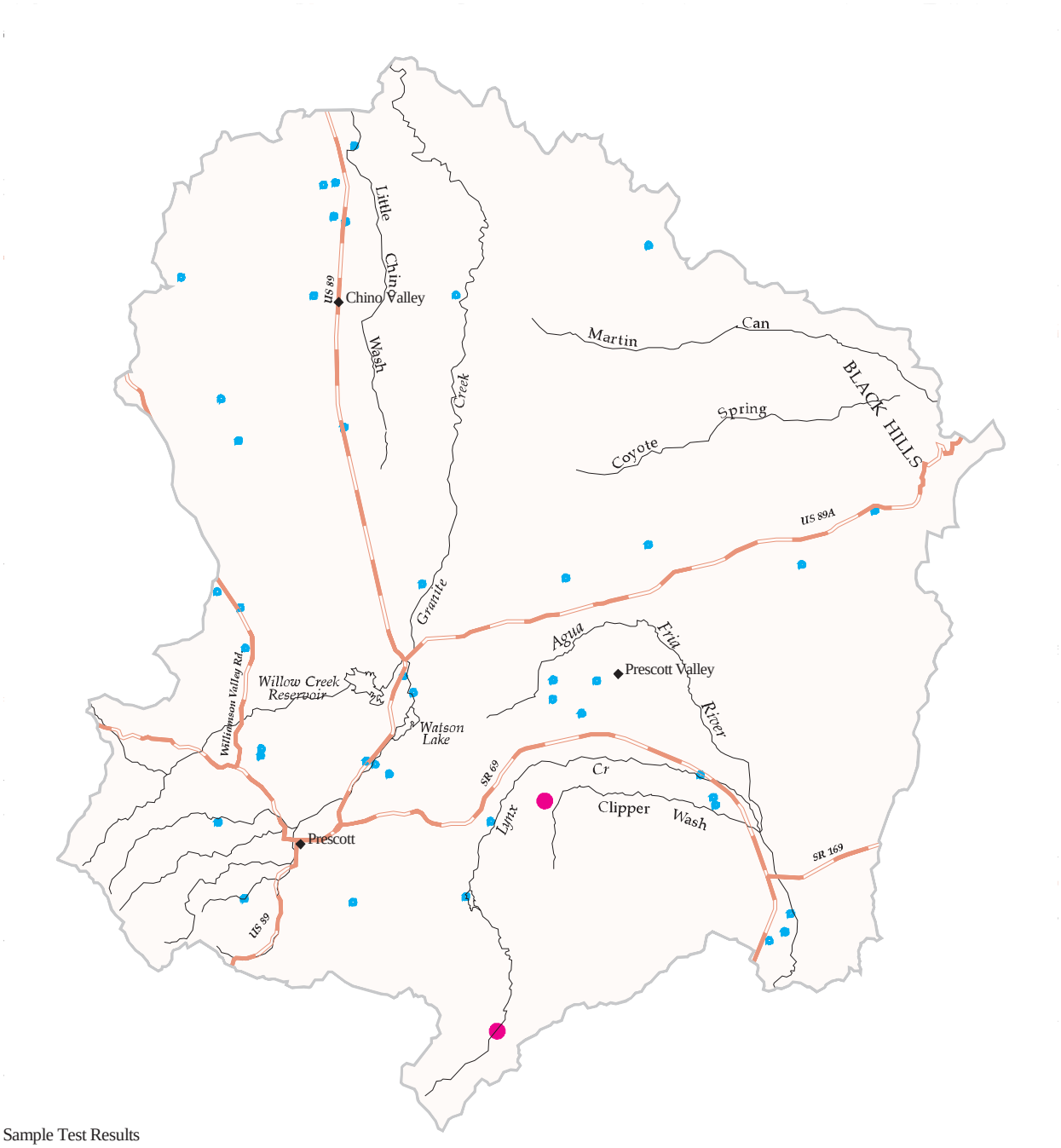
Nitrate Nitrogen and Nitrite Plus Nitrate

0 1 2 3 4 Miles

North

ORIGINAL SOURCE

Arizona Dept of Environmental Quality: Well Locations and Water Quality Samples since 1990



Sample Test Results

- 43 points < SMCL shown
- 2 points >= SMCL shown

Administrative Areas

- Prescott AMA Boundary
- Roads
- Streams
- Cities

Figure 7- 2

Water Quality Sample Test Results

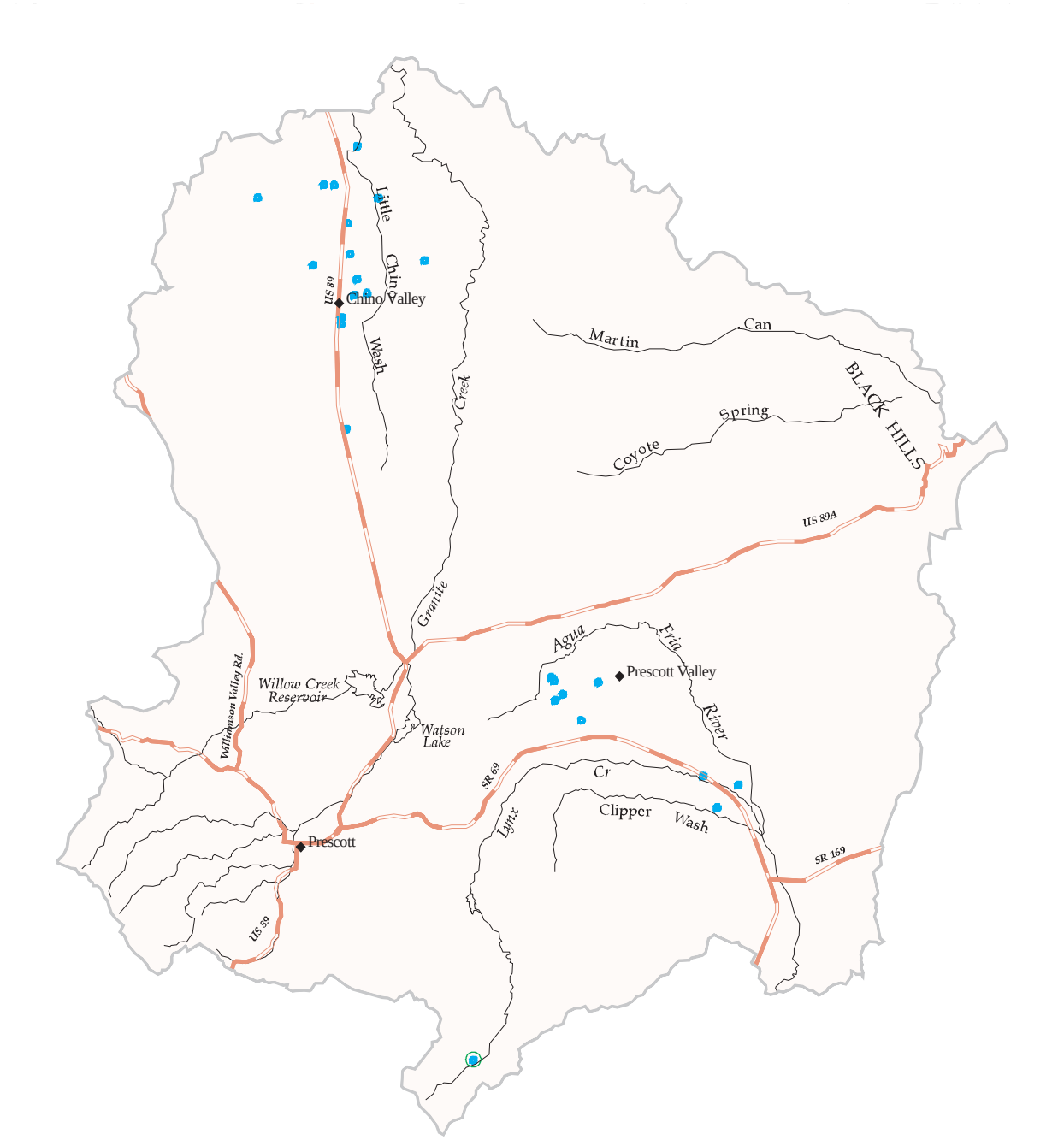
Sulfate

0 1 2 3 4 Miles

North

ORIGINAL SOURCE

Arizona Dept of Environmental Quality:
Well Locations and Water Quality
Samples since 1990



Sample Test Results

- 25 points < 500 mg/L shown
- 1 points >= 500 mg/L and < 1000 mg/L shown
- 0 points >= 1000 mg/L shown

Administrative Areas

- Prescott AMA Boundary
- Roads
- Streams
- Cities

Figure 7- 3

Water Quality Sample Test Results

Total Dissolved Solids

0 1 2 3 4
Miles

North

ORIGINAL SOURCE

Arizona Department of Water Resources:
GWSI Well Locations
Water Quality Samples since 1990
Calculated from Specific Conductivity

The health effects associated with exposure to metals vary depending on the constituent and concentrations. Some metals such as selenium and chromium are known to be essential for human nutrition and are beneficial in certain concentrations. Others, such as lead, have no known beneficial effects on human or animal development and are harmful in high concentrations. Limitations imposed on industrial and agricultural water use by high concentrations of metals vary considerably depending on the contaminant present and the associated use.

7.5.4.5 Volatile Organic Compounds

VOCs, such as trichloroethylene (TCE) and tetrachloroethylene (PCE), are chemicals that evaporate easily but do not readily dissolve in water. Other VOCs include acetone, vinyl chloride, 1,2-dichloroethane, benzene, 1,1-dichloroethylene, 1,1-dichloroethane, chloroform, toluene, and methylene chloride. VOCs are present in, or are used for the manufacturing of, many substances including degreasers, solvents, plastics, paint, varnish, finish removers, detergent, medicine, and gasoline. When found in groundwater, VOCs are usually associated with industrial areas, landfills, and other sites used for the improper disposal of chemicals.

There are no WQARF or CERCLA sites currently within the Prescott AMA. Due to the lack of these sites, groundwater VOC samples were not collected in the Prescott AMA.

Health effects associated with VOCs in drinking water are complex and vary with the types of compounds and concentrations present. Some VOCs such as TCE, are suspected human carcinogens while others have been associated with damage to internal organs. Drinking water supplies which exceed MCLs for VOCs must be treated prior to use.

Potential industrial and agricultural applications of water containing VOCs must be examined on an individual basis.

7.5.4.6 Petroleum Hydrocarbons

This class of contaminants includes non-halogenated hydrocarbons such as benzene, toluene, ethylbenzene, and xylenes, which are ingredients of gasoline and other fuels. MCLs have been established for the primary ingredients in gasoline and other fuels. These contaminants can affect groundwater as a result of, among other things, leaking USTs. According to ADEQ, there are over 5,700 leaking UST sites in Arizona. Only a small percentage of these sites are causing groundwater contamination, however. Petroleum hydrocarbons may naturally attenuate over time depending on the physical, chemical, and microbiological conditions in the aquifer.

In Yavapai County, approximately 75 open leaking UST facilities were identified out of a total of about 85 registered open UST facilities. In the City of Prescott's vicinity, a few leaking UST facilities have been reported, but they are not considered a threat to the aquifer. The probable source of contamination at most of these locations is leaking tanks associated with gasoline stations, commercial, and industrial sites. The sites identified have varying degrees of groundwater contamination and are in various stages of remediation. Petroleum hydrocarbon information is not specifically represented on a water quality map in this chapter.

7.5.4.7 Pesticides

Pesticides are synthetic organic chemicals which are used as insecticides, rodenticides, and herbicides. One of the best known pesticides is the chemical compound 1,1,1-trichloro-2,2-bis (p-chlorophenyl) ethane, otherwise known as DDT. DDT is a water-insoluble compound that has a long residual life. DDT was used extensively until it was banned in 1973.

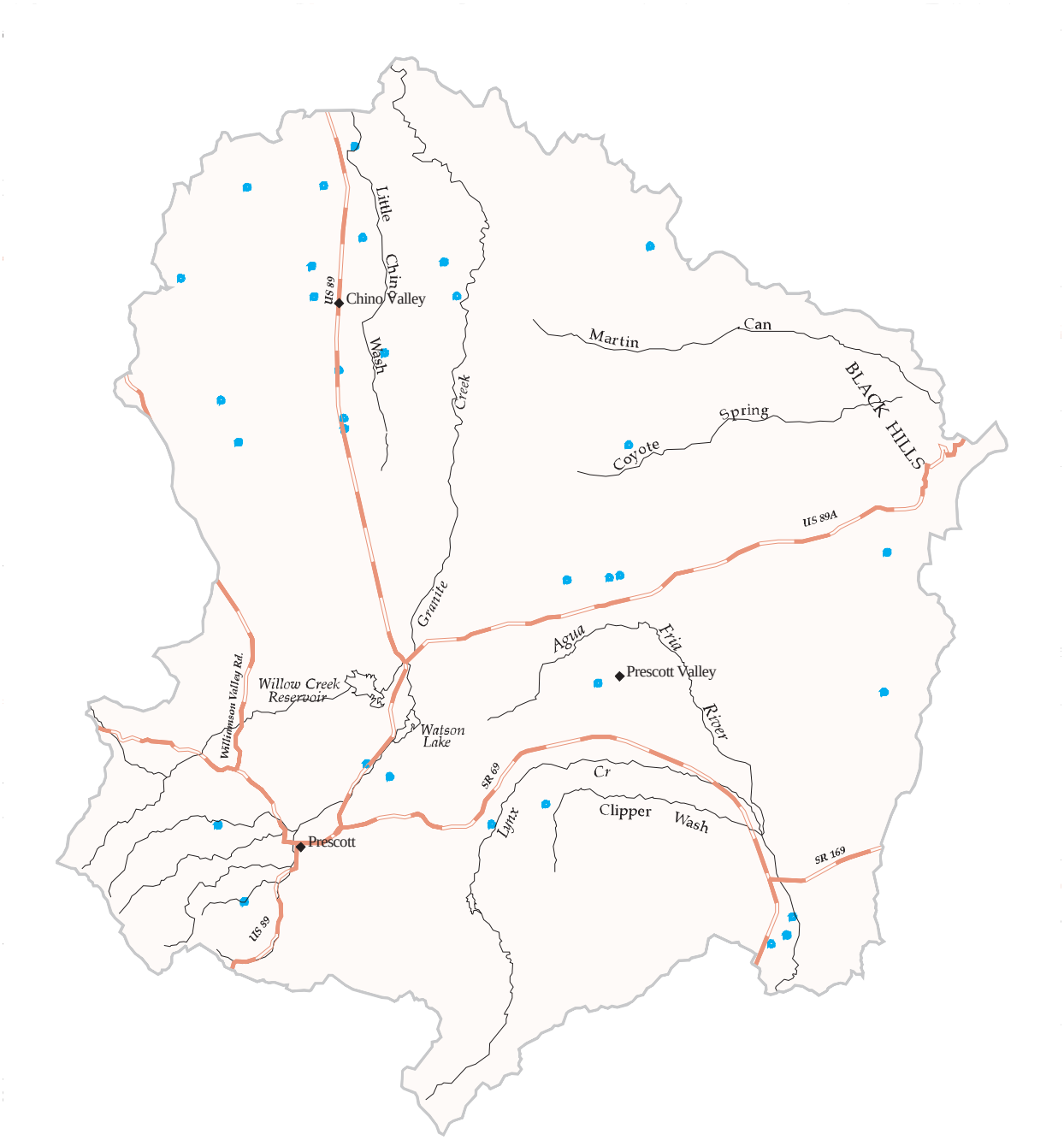


Figure 7- 4

Water Quality Sample Test Results

Metals

ORIGINAL SOURCE

Arizona Dept of Environmental Quality:
Well Locations and Water Quality
Samples since 1990

The health effects of pesticide exposure in water are varied and complex, depending on both the pesticide's inert and active ingredients and reaction with substances contained in the water. Drinking water supplies can be affected by pesticide contamination. The presence of pesticides can restrict some industrial water uses such as animal based industries, because elevated concentrations of pesticides may bioaccumulate (accumulate in living tissue) as they are passed through the food chain. Pesticides that are used for agriculture can also bioaccumulate, thus restricting the use of particular chemicals on edible crops.

7.5.4.8 Fluoride

Fluorides are compounds found in rocks and soil and some industrial waste products. Fluorides are used primarily in manufacturing and as a drinking water additive for the prevention of tooth decay. Fluoride occurs naturally in groundwater; however, its potential for domestic or municipal use depends on the concentration level. Elevated concentrations can cause mottling of teeth and skeletal effects. The EPA primary MCL for fluoride is 4.0 mg/l and the recommended SMCL is 2.0 in order to prevent mottling of teeth.

Fluoride concentrations in the Prescott AMA are shown in Figure 7-5. Fluoride concentrations in excess of the MCL are not prevalent in the Prescott AMA.

7.5.4.9 Radiochemicals

Radioactive elements such as uranium, radon, and radium occur naturally in soil and water at locations throughout Arizona. The federally proposed MCL level for radon is 300 picocuries per liter (pCi/l), but radon in groundwater is not regulated. The EPA is currently collecting data on radon occurrences and conducting a health effects study prior to promulgating a radon standard for drinking water. Inhalation of radon may be harmful when it is released to the air from a contaminated water source. The primary concern of using radon-contaminated water is to ensure that the release of emissions are below air quality standards when processes such as cooling towers, construction aggregate washing, and sprinkler irrigation are used.

Due to the lack of available data, groundwater quality maps depicting radiochemical concentrations were not produced for this chapter. Several radioactive elements occur naturally in soil and water. Uranium mining activities which include waste dumps and mine tailings, as well as mine dewatering, can contaminate groundwater with radiochemicals.

In the Prescott AMA, naturally occurring contaminants such as radon affect groundwater in some areas which are generally located near hardrock formations.

7.5.5 Specific Contamination Areas

The Prescott AMA does not contain any remedial sites that are listed on the WQARF Priority List or the CERCLA National Priority List.

7.6 SUMMARY

Groundwater quality has not historically been a significant problem within the Prescott AMA. Increasing demands on water resources and expanding development, however, could raise the risk of future groundwater contamination.

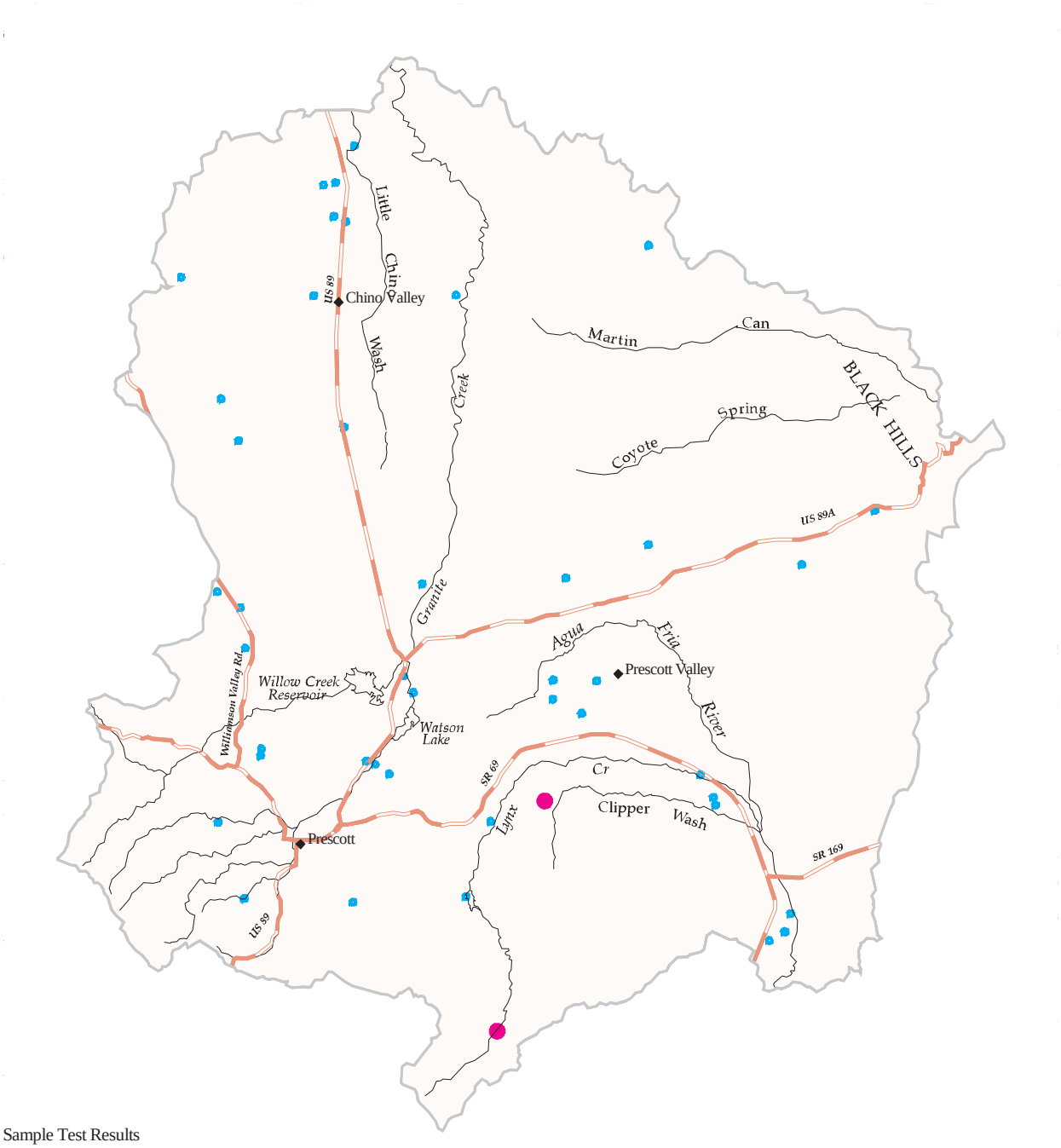


Figure 7- 5

Water Quality Sample Test Results

Fluoride

ORIGINAL SOURCE

Arizona Dept of Environmental Quality:
Well Locations and Water Quality
Samples since 1990

As WQARF activities progress, addressing water management issues such as available supply and reuse options will become essential to ensure a long-term water supply of adequate quality. The ability to recognize specific groundwater management requirements for contaminated and degraded aquifer conditions will also become increasingly important as the demands for water increase.

During the first and second management periods, ADEQ emphasized pump and treat remedies to cleanup poor quality groundwater in aquifers within other AMAs. Success was limited, however, due to lengthy periods of litigation which have seriously restricted actual cleanup activities. With the advent of the WQARF reform package of 1997, a new approach emphasizing incentives to cleanup and flexibility in the selection of remedies was developed to improve the likelihood that sites will actually become remediated.

The 1997 WQARF reform legislation creates an incentive for the use of groundwater withdrawn in accordance with approved remedial action projects pursuant to Title 49, Arizona Revised Statutes, or CERCLA. It provides that such groundwater must be accounted for consistent with accounting for surface water conservation requirements and that the use of certain volumes of such groundwater is consistent with achievement of the management goal of the AMA until the year 2025. During the third management period, the Department will amend its Assured Water Supply Rules to conform to these provisions. Additionally, permanent rules regarding well spacing and impact will be promulgated by the Department during the third management period. The Department also intends to integrate water quality concerns more fully into its underground water storage programs.

During the third management period, the Department will be committed to enacting and implementing the provisions outlined in this chapter. This commitment will encompass several new provisions and activities summarized below.

- An on-going groundwater quality assessment in cooperation with ADEQ will assist with the evaluation of existing rules and provisions.

- Integration of groundwater quality management into recharge planning and permitting, and the development of incentives to use remediated groundwater where appropriate.

- Formal permit coordination with ADEQ in order to cooperate on both Title 45 and Title 49 permits. Basin-wide or non-site-specific tracking and coordination of all permits will provide both agencies with a more complete picture of contaminant distribution, groundwater withdrawals, and releases to groundwater and surface water on a basin-scale perspective.

- Evaluation of the need for additional incentives to withdraw and use remediated groundwater within the AMAs throughout the third management period in an effort to match quality with beneficial use. This evaluation will include groundwater that may be contaminated with hazardous, non-hazardous, and naturally occurring substances. Incentives may involve amendments to Arizona Revised Statutes, Title 45, Department rules and policies, or a modification of the management plans.

- The Department and ADEQ will develop and enter into Memorandums of Understanding as necessary to establish, among other things, the division of responsibilities for the implementation of the reformed WQARF program, development of common scopes of work for WQARF sites and other groundwater contamination sites, as well as database development and exchange.

The Department's Water Quality Section, which was established with funding provided by the 1997 WQARF reform legislation, will allow the Department to strengthen its commitment to work closely with ADEQ to resolve groundwater quantity and quality issues. Monies committed by the WQARF reform bill will expedite the cleanup of remedial sites.

Other remedial activities such as those associated with Superfund sites will continue to include the Department's direct involvement. This will ensure that remedial activities meet the Department's water management objectives and are consistent with the AMA's safe-yield goal.

7.7 FUTURE DIRECTIONS

The Department's long range plans for groundwater quality management will focus on two areas: (1) evaluation of groundwater quality issues on a non-site-specific level in order to understand the impact of groundwater quality issues on water resource management on a broader level and (2) preservation of AMA management goals with emphasis on implementing incentives to use remediated groundwater.

7.7.1 Non-Site-Specific Water Quality Management

Non-site-specific groundwater quality management refers to groundwater quality management activities which may occur in general areas located outside of an identified WQARF or CERCLA boundary.

Significant volumes of groundwater in Arizona have been contaminated or degraded to varying degrees due to human activities. Groundwater contaminated with substances such as nitrate, sulfate, and dissolved solids (major cations and anions) generally result from non-point source pollution and can cause significant service problems for water providers and other water users. For example, groundwater containing high concentrations of TDS can cause scaling problems in cooling towers, is unsuitable for use on some crops, and can cause aesthetic problems in drinking water.

The cessation or decrease of groundwater withdrawals in some areas due to groundwater quality concerns can cause water tables to rise, exposing groundwater to contaminated soils or plume migration to other wells. For example, this condition can exist when soil contaminated by a leaking underground storage tank comes in contact with rising groundwater levels. Contaminated soils associated with landfills may also be inundated by rising water tables. These conditions need to be monitored for impacts on groundwater quality. Ultimately, proper planning will ensure that the impacts of groundwater recharge projects do not contribute to the degradation of aquifer conditions.

To address and mitigate dispersed contamination over large areas, a broader management strategy is needed. Areas which may need more intensive management can include those where public supply wells have been or may be affected by contamination. For instance, areas that are in the vicinity of major population centers or agricultural areas can be affected by contamination, especially if large volumes of groundwater are pumped, creating cones of depression.

The concept of groundwater quality management on a non-site-specific scale (general areas outside of identified site boundaries) will be developed to enhance water management activities in critical areas. The identification of source groundwater quality and the development of area-specific plans to match groundwater quality with the intended use will become an important aspect in the third management period. The Department intends to study the development of area-specific plans that could employ a combination of strategies to evaluate and mitigate the effects of contamination in critical areas. These plans should be developed in coordination with ADEQ and with affected stakeholders. Any contaminant management on a non-site-specific scale will be voluntary and will not affect rights to groundwater, well ownership, delivery responsibilities, or existing permits.

7.7.2 Preservation of AMA Management Goals

The WQARF reform package of 1997 was designed to encourage the remediation of groundwater that has limited or no use due to contamination. Pump and treat groundwater remediation activities are anticipated

to increase substantially during the third management period as a result of the remediated groundwater use incentives provided in the WQARF reform package. As a result, previously unavailable sources of groundwater from contaminated areas may be put to considerable use. Remediated groundwater withdrawals associated with WQARF, CERCLA, Department of Defense, RCRA, and voluntary site cleanups are expected to increase.

In the third management period, the Department will monitor water levels, subsidence, and effects on local water providers at remedial project sites in areas of intensive pumping, which generally are concentrated within the major urban centers of Arizona. While the Department supports the remediation of contaminated groundwater, it also seeks to preserve the management goals of each AMA, of which the most predominant is the concept of safe-yield. Water quality management is a lengthy process which will likely continue far beyond the scope of the third management period. Continued remedial activities over the long-term will likely result in considerable volumes of groundwater being pumped, treated, and subsequently used.

The net effect of continued remediated groundwater withdrawals could result in a substantial increase in the overall volume of groundwater put to use within an AMA. Without proper coordination in both water resource and groundwater quality management, these actions could seriously jeopardize the goal of safe-yield by creating new groundwater uses. Remediated groundwater does not represent a renewable water supply. There are limited supplies of poor quality groundwater as well as groundwater of acceptable quality. Consequently, the Department will seek to preserve the intent of the Code and the AMA management goals to protect water resources while cooperating with ADEQ to promote groundwater quality management.

APPENDIX 7A
DRINKING WATER STANDARDS AND HEALTH EFFECTS
PRESCOTT ACTIVE MANAGEMENT AREA

Contaminants	Primary MCL (mg/l)[1]	Potential Health Effects from Ingestion of Water	Sources of Contaminants in Drinking Water
Inorganics			
Antimony	0.006	Cancer	Fire retardants, ceramics, electronics, fireworks, solder
Arsenic	0.05	Skin, nervous system toxicity	Natural deposits; smelters, glass, electronics waste
Asbestos	7.0 MFL[2]	Cancer	Natural deposits, asbestos cement in water systems
Barium	2.0	Circulatory system effects	Natural deposits, pigments, epoxy sealants, spent coal
Beryllium	0.004	Bone, lung damage	Electrical, aerospace, defense industries
Cadmium	0.005	Kidney effects	Galvanized pipe corrosion; natural deposits, batteries, paints
Chromium (total)	0.1	Liver, kidney, circulatory disorders	Natural deposits; mining, electroplating, pigments
Cyanide (as free cyanide)	0.2	Thyroid, nervous system damage	Electroplating, steel, plastics, mining, fertilizer
Fluoride[3]	4.0	Skeletal and dental fluorosis	Natural deposits, fertilizer, aluminum industries
Mercury	0.002	Kidney, nervous system disorders	Crop runoff; natural deposits; batteries, electrical switches
Nickel	Remanded	Gastrointestinal distress, skin irritation, respiratory congestion	Food, water, metal alloys
Nitrate (as N)	10.0	Methemoglobulinemia	Animal waste, fertilizer, sewage natural deposits, septic tanks
Nitrite (as N)	1.0	Methemoglobulinemia	Same as nitrate; rapidly converted to nitrate
Total nitrate/nitrite	10.0	Methemoglobulinemia	Animal waste, fertilizer, sewage natural deposits, septic tanks
Selenium	0.05	Liver Damage	Natural deposits; mining, smelting, coal/oil combustion
Thallium	0.002	Kidney, liver, brain, intestinal	Electronics, drugs, alloys, glass

APPENDIX 7A
DRINKING WATER STANDARDS AND HEALTH EFFECTS
PRESCOTT ACTIVE MANAGEMENT AREA

Contaminants	Primary MCL (mg/l)[1]	Potential Health Effects from Ingestion of Water	Sources of Contaminants in Drinking Water
Volatile Organic Chemicals			
Benzene	0.005	Cancer	Some foods; gas, drugs, paint, pesticides, plastic industries
Carbon tetrachloride	0.005	Cancer	Solvents and degradation by-products
ortho-Dichlorobenzene	0.6	Liver, kidney, blood cell damage	Paints, dyes, engine cleaning compounds, chemical wastes
para-Dichlorobenzene	0.075	Cancer	Room and water deodorants, and mothballs
1,2-Dichloroethane	0.005	Cancer	Leaded gasoline, fumigants, paints
1,1-Dichloroethylene	0.007	Cancer	Plastics, dyes, perfumes, paints
cis-1,2-Dichloroethylene	0.07	Liver, kidney, nervous, circulatory	Waste industrial extraction solvents
trans-1,2-Dichloroethylene	0.1	Liver, kidney, nervous, circulatory	Waste industrial extraction solvents
Dichloromethane	0.005	Cancer	Paint stripper, metal degreaser, propellant, extraction
1,2-Dichloropropane	0.005	Liver, kidney effects; cancer	Soil fumigant; waste industrial solvents
Ethylbenzene	0.7	Liver, kidney, nervous system	Gasoline; insecticides; chemical manufacturing wastes
Monochlorobenzene	0.1	Nervous system and liver effects	Waste solvent from metal degreasing process
Styrene	0.1	Liver, nervous system damage	Plastics, rubber, resin, drug industries; landfill leachate
Tetrachloroethylene	0.005	Cancer	Improper disposal of dry cleaning and other solvents
Toluene	1.0	Liver, kidney, nervous, circulatory	Manufacturing and solvent operations, gasoline additive
1,2,4-Trichlorobenzene	0.07	Liver, kidney damage	Herbicide production, dye carrier
1,1,1-Trichloroethane	0.2	Liver, nervous system effects	Adhesives, aerosols, textiles, paints, inks, metal degreasers
1,1,2-Trichloroethane	0.005	Kidney, liver, nervous system	Solvent in rubber, other organic products; chemical production wastes

APPENDIX 7A
DRINKING WATER STANDARDS AND HEALTH EFFECTS
PRESCOTT ACTIVE MANAGEMENT AREA

Contaminants	Primary MCL (mg/l)[1]	Potential Health Effects from Ingestion of Water	Sources of Contaminants in Drinking Water
Trichloroethlylene	0.005	Cancer	Textiles, adhesives, and metal degreasers
Vinly chloride	0.002	Cancer	May leach from PVC pipe; formed by solvent breakdown
Xylenes (total)	10.0	Liver, kidney, nervous system	By-product of gasoline refining; paints, inks, detergents
Synthetic Organic Chemicals			
Alachlor	0.002	Cancer	Runoff from herbicides applied to crops
Atrazine	0.003	Mammary gland tumors	Runoff from herbicides used on crops and non-cropland
Benzo(a)pyrene	0.0002	Cancer	Fossil fuels, burning organic matter, coal tar coatings, volcanics
Carbofuran	0.04	Nervous, reproductive system effects	Soil fumigant; some area restrictions apply
Chlordane	0.002	Cancer	Leaching from soil treatment for termites
2,4-D	0.07	Liver and kidney damage	Runoff from herbicides applied to crops, rangelands, and lawns
Dalapon	0.2	Liver and kidney effects	Herbicide on orchards, crops, lawns, road/railways
Dibromochloropropane	0.0002	Cancer	soil fumigant
Di(2-ethylhexyl)adipate	0.4	Decreased body weight	Synthetic rubber, food packaging, cosmetics
Di(2-ethylhexyl)phthalate	0.006	Cancer	PVC and other plastics
Dinoseb	0.007	Thyroid, reproductive organ damage	Runoff of herbicide from crop and non-crop applications
Diquat	0.02	Liver, kidney, eye effects	Runoff of herbicide on land and aquatic weeds
Endothall	0.1	Liver, kidney, gastrointestinal	Herbicide on crops, land/aquatic weeds; rapidly degraded
Endrin	0.002	Liver, kidney, heart damage	Pesticide on insects, rodents, birds; restricted since 1980

APPENDIX 7A
DRINKING WATER STANDARDS AND HEALTH EFFECTS
PRESCOTT ACTIVE MANAGEMENT AREA

Contaminants	Primary MCL (mg/l)[1]	Potential Health Effects from Ingestion of Water	Sources of Contaminants in Drinking Water
Ethylene dibromide	0.00005	Cancer	Leaded gasoline additives; leaching of soil fumigant
Glyphosate	0.7	Liver, kidney damage	Herbicide on grasses, weeds, brush
Heptachlor	0.0004	Cancer	Leaching of insecticide for termites and very few crops
Heptachlor epoxide	0.0002	Cancer	Biodegradation of heptachlor
Hexachlorobenzene	0.001	Cancer	Pesticide production waste by-product
Hexachlorocyclopentadiene	0.05	Kidney, stomach damage	Pesticide production intermediate
Lindane	0.0002	Liver, kidney, nervous, immune circulatory	Insecticide on cattle, lumber, gardens; restricted in 1983
Methoxychlor	0.04	Growth, liver, kidney, nerve effects	Insecticide for fruits, vegetables, alfalfa, livestock, pets
Oxamyl (Vydate)	0.2	Kidney damage	Insecticide on apples, potatoes, tomatoes
Pentachlorophenol	0.001	Cancer, liver, kidney effects	Wood preservatives, herbicide, cooling tower wastes
Picloram	0.5	Kidney, liver damage	Herbicide on grass sod, some crops, aquatic algae
Polychlorinated biphenyls	0.0005	Cancer	Coolant oils from electrical transformers; plasticizers
Simazine	0.004	Cancer	Herbicide on grass sod, some crops, aquatic algae
2,3,7,8-TCDD (Dioxin)	3×10^{-8}	Cancer	Chemical production by-product; impurity in herbicides
Toxaphene	0.003	Cancer	Insecticide on cattle, cotton, soybeans; canceled in 1982
2,4,5-TP (Silvex)	0.05	Liver and kidney damage	Herbicide on crops, right-of-way, golf courses; canceled in 1983

APPENDIX 7A
DRINKING WATER STANDARDS AND HEALTH EFFECTS
PRESCOTT ACTIVE MANAGEMENT AREA

Contaminants	Primary MCL (mg/l)[1]	Potential Health Effects from Ingestion of Water	Sources of Contaminants in Drinking Water
Radionuclides			
Combined Radium-226 and Radium-228	5 pCi/l[4]	Bone Cancer	Natural deposits
Gross Alpha[5]	15 pCi/l	Cancer	Decay or radionuclides in natural deposits
Gross beta	4 mrem/yr[6]	Cancer	Decay of radionuclides in natural and man-made deposits
Radon-222 (Proposed)	300 pCi/l	Cancer	Natural sources
Uranium (Proposed)	20 µg/l[7]	Cancer	Natural sources
Microbiology			
Giardia lamblia	TT[8]	Gastroenteric disease	Human and animal fecal waste
Legionella	TT	Legionnaire's disease	Indigenous to natural waters; can grow in water heating systems
Standard Plate Count	TT	Indicates water quality, effectiveness of treatment	
Total Coliform	[9]	Indicates gastroenteric pathogens	Human and animal fecal waste
Turbidity	[9]	Interferes with disinfection, filtration	Soil runoff
Viruses	TT	Gastroenteric disease	Human and animal fecal waste
Total Trihalomethanes	0.1	Cancer	Drinking water chlorination by-products

[1] mg/l = milligrams per liter (all MCLs are in mg/l unless otherwise indicated)
[2] "MFL" means million fibers per liter greater than ten microns
[3] The MCL for fluoride applies to community water systems only
[4] pCi/l = picocuries per liter (30pCi/l is equivalent to 20 µg/l)
[5] Gross particle activity, including Radium-226 but excluding Radon and Uranium
[6] mrem/yr = millirem per year, see ADEQ, Drinking Water Rules source (1) for more information
[7] µg/l = micrograms per liter
[8] Treatment Technology (refer to source (1) for more information)
[9] Refer to source (1) for more information

Sources: Arizona Department of Environmental Quality, Arizona Drinking Water Rules, April 28, 1995
United States Environmental Protection Agency, Office of Water 4304, EPA 822-B-96-002, October 1996
United States Environmental Protection Agency, National Primary Drinking Water Regulations, Appendix A: National Primary Drinking Water Standards (Modified 1/14/98)

APPENDIX 7B
SECONDARY DRINKING WATER STANDARDS[1]
PRESCOTT ACTIVE MANAGEMENT AREA

Contaminants	SMCLs (mg/l)[2]
Aluminum	0.05 to 0.2
Chloride	250
Color	15 color units
Copper	1.0
Corrosivity	non-corrosive
Fluoride	2.0
Foaming agents	0.5
Iron	0.3
Manganese	0.05
Odor	3 threshold odor numbers
pH	6.5 - 8.5
Silver	0.1
Sulfate	250
Total dissolved solids	500
Zinc	5

1 Secondary Drinking Water Standards are unenforceable federal guidelines regarding taste, odor, color and certain other non-aesthetic effects of drinking water. States may adopt their own enforceable regulations governing these concerns.

2 Secondary Maximum Contaminant Levels (SMCLs) units are in milligrams per liter (mg/l) unless otherwise indicated.

Source: United States Environment Protection Agency, Office of Water 4304, EPA 822-B-96-002, October 1996